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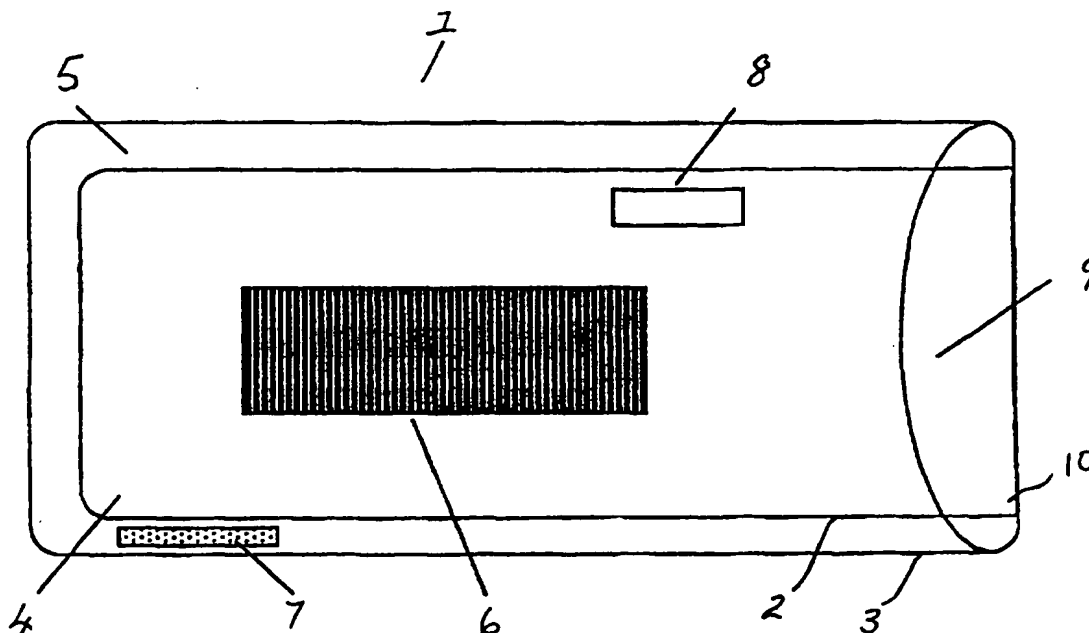
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(54) Title: TAMPER EVIDENT PACKAGING



(57) Abstract

A tamper evident package comprises an inner membrane (2) defining an inner compartment (4), containing a first atmosphere of air, and an outer membrane (3) defining an outer compartment (5) surrounding the inner compartment, and containing a second atmosphere containing carbon dioxide. An atmospherically sensitive indicator strip (7) is arranged within outer compartment (5) and is capable of providing an indication of a change in the first and second atmospheres.

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### Tamper Evident Packaging

The present invention is concerned with tamper evident packaging.

Several forms of tamper evident packaging and sealing means capable of providing an indication that the packaging or sealing means have been tampered with are known.

For example, US 4813541 describes a tamperproof package comprising an outer container completely surrounding an inner container, the region between the containers comprising a selected atmosphere. The package is further provided with a sensor responsive to a change in the gaseous composition of the selected atmosphere. Although the tamperproof package is capable of indicating invasion of the selected atmosphere by a foreign gaseous medium, the package is not capable of providing a positive indication of undesirable gaseous penetration into the inner container.

I have now developed a tamper evident packaging which helps to alleviate the above problem.

According to the present invention, there is provided a tamper evident package comprising:

- (a) first surround means arranged to provide an inner compartment containing a first atmosphere;
- (b) second surround means arranged to provide an outer hermetically sealed compartment completely surrounding said inner compartment, said outer compartment containing a second atmosphere; and
- (c) atmospherically sensitive indicating means arranged in contact with said second atmosphere, such that a visual indication of a change in the gaseous composition of either said first atmosphere or said second atmosphere can be provided by said indicating means located in said outer compartment.

The first and second surround means preferably comprise first and second membranes impervious to the passage of gas therethrough. Preferably the first and second

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membranes comprise metallised polyethylene. Advantageously, there is provided a transparent or translucent window in the outer membrane behind which the indicating means can be viewed.

The second surround membrane is preferably arranged as a sheath around the first surround membrane, so as to be suitable for maintaining the second atmosphere as a gaseous envelope surrounding the inner compartment.

The inner compartment, which may, in some embodiments, be hermetically sealed, is typically dimensioned so as to be suitable for storing goods therein. Preferred goods for storage within a package according to the present invention include documents, pharmaceuticals, foodstuffs, valuables, medical apparatus or the like.

The indicating means typically comprise at least one colorimetric indicator, convertible from a first colour to a second, distinguishable, colour in response to a change in the second atmosphere in communication with the indicator. The indicating means are typically provided in strip form within the outer compartment although it is envisaged that the indicating means may be provided as substantially at least one continuous surface coating provided on the respective surface or surfaces of the surround membranes.

According to a first aspect of the present invention, it is preferred that the first atmosphere enclosed within the tamper evident package contains air, and that the second enclosed atmosphere consists essentially of a gas enriched with a finite volume of carbon dioxide. The second atmosphere may typically comprise a finite volume of air and hence a finite volume of carbon dioxide.

Typically the atmospheric change occurring within the outer compartment is due to ingress of a foreign gaseous medium into the outer compartment. In the case of a package according to the present invention, the foreign gaseous ingress into the outer compartment involves ingress of gas containing carbon dioxide.

It is further preferred that the indicating means, of a package according to the present invention, comprise a carbon dioxide sensitive colorimetric dye which may be reversible or irreversible. The indicating means typically include a carbon dioxide sensitive colorimetric dye, which is preferably capable of undergoing an irreversible colour change.

A suitable carbon dioxide sensitive dye in such an irreversible or reversible indicator includes an indicator material, being a salt of an indicator anion and a lipophilic organic quaternary cation. The carbon dioxide sensitive indicating means typically comprises an intimate mixture of such an indicator material, a polymer vehicle and a plasticiser therefor.

Preferred indicator anions for the irreversible indicator, include azo dyes and preferred quaternary cations include tetra-octyl ammonium and tricapryl methyl ammonium. Typical polymer vehicles include polyvinyl butyral (typically of molecular weight about 36,000) and ethyl cellulose (46% ethoxyl content). A preferred plasticiser is tris (2-ethyl-hexyl) phosphate.

Alternatively, for the reversible indicator a preferred indicator anion includes creosol purple and a preferred quaternary cation includes tetrabutyl ammonium hydroxide. A typical polymer vehicle includes ethyl cellulose. A preferred plasticiser is tri-n-butyl phosphate.

In a preferred embodiment, the first atmosphere comprises air and the second atmosphere consists essentially of a gas, typically air, containing a finite volume of carbon dioxide. Advantageously, the indicator strip is permeable to allow free diffusion of gas molecules between the film and the gas phase. The indicating means is capable of absorbing a finite volume of carbon dioxide without any corresponding colour change in the indicator. Advantageously, the finite volume of carbon dioxide contained in the outer compartment is below the carbon dioxide critical capacity of the indicating means to effect a colour change.

When the package is breached, the outer membrane allows an influx of air leading to a change in the atmosphere in the outer compartment and a resulting colour change in the indicating means due to interaction of the indicator with increased levels of carbon dioxide in the inflowing air. There is no substantial change in the atmosphere in the inner compartment. The increased volume of carbon dioxide in the outer compartment resulting from the ingress of air, exceeds the critical capacity of the indicating means to carbon dioxide and results in an irreversible colour change in the indicator. /

In the case where the first atmosphere is breached by a syringe or the like, the ingress of air (and hence carbon dioxide) to the second atmosphere from the inner compartment, leads to a colour change in the indicator as previously described. Thus advantageously both tampering by manual opening of the package such as opening or tearing of the package and by injection or the like, may be easily identified.

There is further provided by the present invention a tamper evident package substantially as hereinbefore described, which package is arranged to contain materials, such as documents, pharmaceuticals, foodstuffs, medical apparatus or the like. age materials are typically located within the inner compartment of the tamper evident package. Typically, the package provides a sealed plastics bag or sachet for enclosing the storage materials.

According to a further aspect of the present invention, there is provided a method of providing an article with a tamper evident covering, which method comprises arranging first and second surround means of a package substantially as hereinbefore described so as to envelope said article within said inner compartment of said package, and respectively providing said inner and outer compartments with first and second atmospheres.

It is preferred that the first surround means is initially arranged to enclose the article within a selected atmosphere, typically a carbon dioxide containing atmosphere, such as air; the first surround means being arranged to provide an inner compartment and being capable of precluding ingress or egress of gas relative to the inner compartment.

The second surround means are then typically arranged to surround the above described sealed inner compartment, such that the second surround means maintains the second atmosphere as a gaseous envelope surrounding the inner compartment. The second surround means is arranged to provide a hermetically sealed outer compartment, which is capable of precluding gaseous ingress or egress relative to the outer compartment as described with respect to the first surround means.

The method further comprises arranging indicating means such that a visual indication of a change in the gaseous composition of the atmospheres of the respective compartment can be provided by the indicating means. Preferably a transparent or

translucent window is provided on the outer sealing membrane. The indicating means typically comprise indicator dyes, advantageously provided as strip materials or surface coatings on respective surfaces of the surround means.

According to yet a further aspect of the present invention, there is provided a method of providing an indication of package tampering, which method comprises providing a package substantially as hereinbefore described and monitoring any visual change of said indicating means in response to a change of the gaseous composition of either said first or second atmospheres.

The package is preferably arranged to contain storage material within the inner compartment thereof.

The present invention will now be further illustrated by way of example only with reference to the accompanying drawing in which the sole drawing is a plan view of a tamper evident package according to the invention.

Referring to the drawing, there is shown a tamper-evident package 1, comprising an inner membrane 2, an outer membrane 3, and inner and outer compartments 4, 5 respectively.

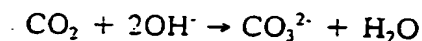
Compartment 4 is suitably dimensioned for receiving stored items 6 therein. Adhesive seal 9 secures the flap 10 of the package securely to the outer surface of the outer membrane 3. The adhesive bond between the flap 10 and the outer membrane 3 is such that any attempt to open the flap 10 results in a tear in the outer membrane 3, typically of metallised vinyl plastics. Compartment 5 is of relatively smaller dimensions than compartment 4, so as to be suitable for maintaining a gaseous film surrounding compartment 4.

Indicator dye strip 7 is arranged within compartment 5, and is capable of providing an indication of a change in the atmosphere within the outer compartment 4. Indicator 7 is sensitive to the presence of carbon dioxide.

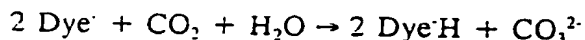
Compartment 4 contains air and compartment 5 contains a finite volume of air and thus a finite volume of carbon dioxide.

Strip 7 is initially blue as it is arranged in contact with the atmosphere of air within compartment 5.

Ingress of air into compartment 5 can effect conversion of strip 7 from blue to red, as a result of reaction of the dye of strip 7 with carbon dioxide within the air. Indicator strip 7 is permeable allowing the free diffusion of gas molecules between the strip 7 and the atmosphere in compartment 5. Any carbon dioxide molecules entering the strip 7 react irreversibly with hydroxyl ions in the strip 7 and remains trapped in the form of carbonate ions.



This process continues until the hydroxyl content of the strip 7 has been fully depleted. Subsequently, any further carbon dioxide entering the strip 7 reacts with the dye anion producing a colour change.



Therefore, the strip 7 will absorb a finite volume of carbon dioxide while exhibiting no visible colour change, but once the critical capacity of the strip 7 to carbon dioxide has been exceeded a rapid colour change occurs. The capacity of the strip 7 depends on its physical dimensions (volume) and the concentration of the incorporated hydroxide base.

Membranes 2 and 3 typically comprise sheeting impervious to the passage of gas therethrough, and are therefore capable of maintaining the atmosphere of compartment 5 as an isolated gaseous medium. Window 8 on the outer membrane 3 is transparent for allowing the colour of the indicator strip 7 to be viewed.

On breach of membranes 2, 3 in the presence of air, strip 7 turns red due to ingress of air (and hence carbon dioxide) into compartment 5. Thus, the volume of carbon dioxide in the atmosphere or from the inner compartment 4, will additionally be absorbed by the indicator strip 7. The change is irreversible and thus records evidence of tampering.

Alternatively, the strip 7 may be reversible and yellow in colour when exposed to the limited carbon dioxide in the outer compartment 5. On exposure to increased levels of carbon dioxide above 1% the strip 7 turns from yellow to blue, and back again to yellow when the level of carbon dioxide is once again reduced to 1% in outer compartment 5.

The metallised foil of membranes 2 and 3 has a very low permeability to carbon dioxide. The limitation of diffusion of carbon dioxide results in a long shelf life.



**CLAIMS:**

1. A tamper evident package comprising:
  - (a) first surround means arranged to provide an inner compartment containing a first atmosphere;
  - (b) second surround means arranged to provide an outer hermetically sealed compartment completely surrounding said inner compartment, said outer compartment containing a second atmosphere; and
  - (c) atmospherically sensitive indicating means arranged in contact with said second atmosphere, such that a visual indication of a change in the gaseous composition of either said first atmosphere or said second atmosphere can be provided by said indicating means located in said outer compartment.
2. A package according to claim 1, wherein said first and second surround means comprise respective membranes impervious to the passage of gas therethrough.
3. A package according to claim 1 or 2, wherein said membranes each comprise metallised polyethylene.
4. A package according to any preceding claim, wherein said outer membrane has a transparent or translucent window through which the indicating means can be viewed.
5. A package according to any preceding claim, wherein said second surround means comprises a sheath around said first surround means.
6. A package according to any preceding claim, wherein said inner compartment is hermetically sealed.

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7. A package according to any preceding claim, wherein said indicating means comprise at least one colorimetric indicator, convertible from a first colour to a second, distinguishable, colour in response to a change in said second atmosphere in communication with said indicator.
8. A package according to claim 7, wherein said indicating means is in strip form within said outer compartment.
9. A package according to any preceding claim, wherein said indicating means comprises at least one substantially continuous surface coating provided on the respective surface or surfaces of said surround means.
10. A package according to any preceding claim, wherein said first atmosphere contains air, and said second atmosphere consists of a gas containing carbon dioxide in a greater proportion than in said air.
11. A package according to any preceding claim, wherein said indicating means comprises a carbon dioxide sensitive colorimetric dye.
12. A package according to any of claim 11, wherein said indicating means comprises an intimate mixture of said dye, a polymer vehicle and a plasticiser therefor.
13. A package according to claim 11 or 12, wherein said dye is a salt of an indicator anion and a lipophilic organic quaternary cation.
14. A package according to claim 13, wherein said dye comprises an irreversible azo dye.
15. A package according to claim 13 or 14, wherein said dye is irreversible and said quaternary cation is tetra-octyl ammonium or tricapryl methyl ammonium.

16. A package according to claims 13 or 14, wherein said dye is reversible and said indicator comprises cresol purple.
17. A method of providing an article with a tamper evident covering, which method comprises arranging first and second surround means of a package according to any of claims 1 to 16 so as to envelope said article within said inner compartment of said package, and respectively providing said inner and outer compartments with first and second atmospheres.
18. A method according to claim 17, wherein said first surround means is initially arranged to enclose said article within a selected atmosphere, said first surround means being arranged to provide an inner compartment and being capable of precluding ingress or egress of gas relative to said inner compartment.
19. A method according to claim 18, wherein said selected atmosphere is a carbon dioxide containing atmosphere.
20. A method according to claim 19 wherein said atmosphere is air.
21. A method according to any of claims 17 to 20, wherein said second surround means is arranged to surround said sealed inner compartment, such that said second surround means maintains said second atmosphere as a gaseous envelope surrounding said inner compartment.
22. A method according to any of claims 17 to 21, wherein said second surround means is arranged to provide a hermetically sealed outer compartment which is capable of precluding gaseous ingress or egress into or from said outer compartment.

23. A method according to any preceding claim which further comprises arranging indicating means providing a visual indication of a change in the gaseous composition of the atmospheres of the respective compartments.
24. A method according to any of claims 17 to 23, wherein said outer sealing membrane has a transparent or translucent window.
25. A method according to any of claims 17 to 24, wherein each of said indicating means comprises an indicator dye material, provided as a strip material or surface coating on a respective surface of said surround means.
26. A method of providing an indication of package tampering, which method comprises providing a package according to claims 1 to 16, and monitoring any visual change of said indicating means in response to a change of the gaseous composition of either said first or second atmosphere.

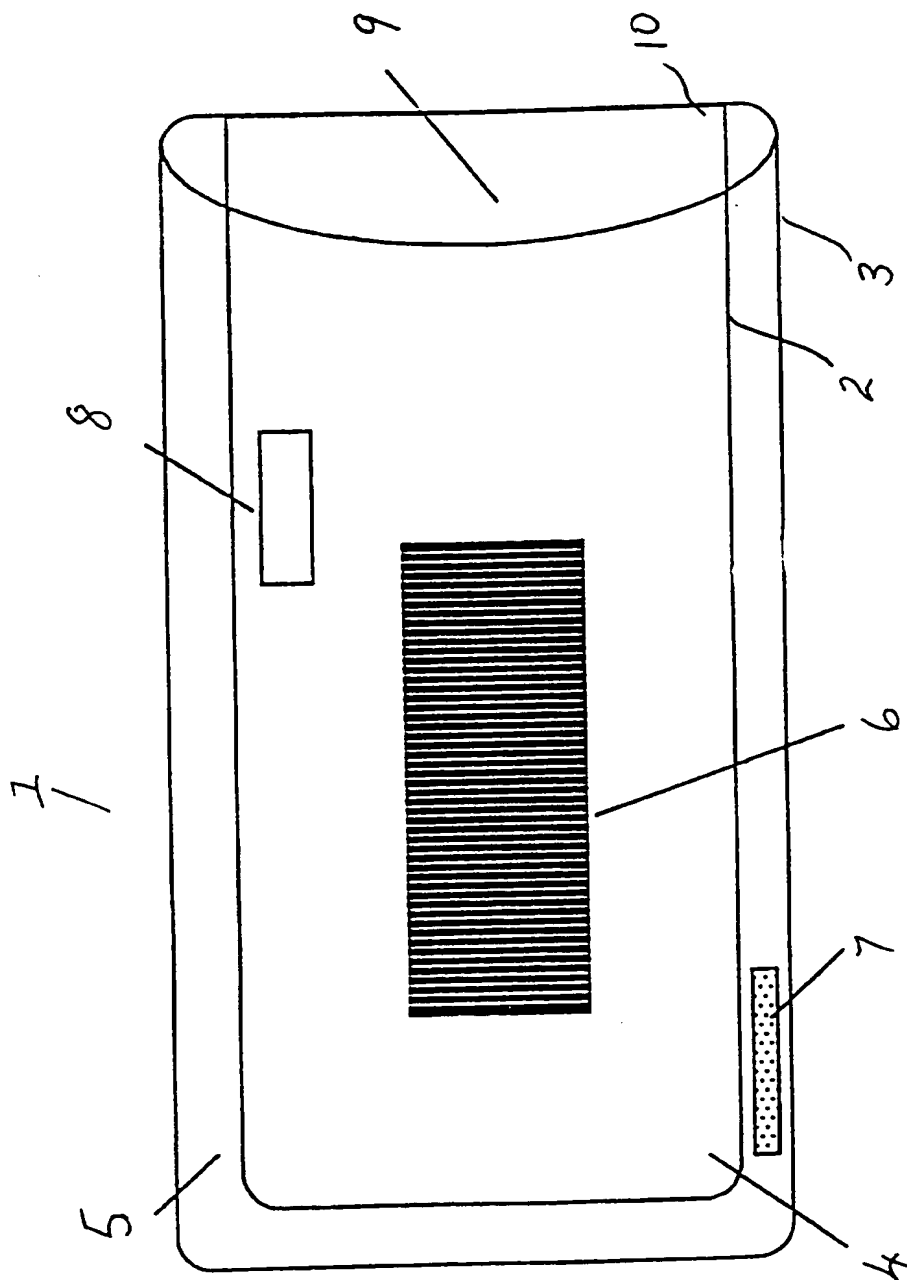


Figure 1

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 95/02470

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 B65D77/04 B65D55/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 813 541 (VELASCO ET AL.) 21 March 1989 cited in the application	1,4-9, 17,18, 21-26
Y	see abstract; figures	3,10,11, 19,20
A	---	2
P,Y	EP,A,0 627 363 (TRIGON INDUSTRIES) 7 December 1994 see abstract; figures	10,11, 19,20
Y	EP,A,0 125 107 (AMERICAN CAN COMPANY) 14 November 1984 see abstract	3
A	WO,A,90 03632 (RICHARDSON) 5 April 1990 see abstract	
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

1 March 1996

Date of mailing of the international search report

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International Application No  
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB,A,2 235 187 (SUNMAN) 27 February 1991 see abstract	
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A	FR,A,2 252 619 (BIO-MEDICAL SCIENCES) 20 June 1975 see claims	
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No

PCT/GB 95/02470

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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